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McGraw, Leigh K., PhD, RN, LTC, AN, USA

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917 Pacific Avenue
Suite 600
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14. ABSTRACT

Purpose: To test the feasibility and determine the effect size of using a Mental Skills Training (MST) intervention to improve performance of Army Nurses in a simulated Combat Casualty Stress Scenario (CCSS) and explore the relevance of individual differences in performance, behavioral response and physiologic response to the stressor. **Design**: The study used a randomized, controlled, blinded design using repeated measures design to test the procedures, measures, and a simulated scenario needed to evaluate the effectiveness of ACEP training on nurse performance under stress. **Methods**: The intervention group received 16 hours of MST and the control group continued to work and train on their assigned nursing units. The CCSS employed a combination of medical triage, treatment and implementation of common soldier skills. Before, during, and after the 10 minute CCSS, salivary alpha amylase and cortisol were collected; blood pressure and heart rate were also recorded. **Sample**: A convenience sample of 38 Army Nurses from Madigan Army Medical Center volunteered to participate in the study. **Analysis**: Descriptive statistics, repeated measures analysis of variance, Pearson's correlation, and both paired an independent t tests were used to examine the data. **Findings**: Results suggest the CCSS is an effective stressor, with large magnitude increases in all physiologic parameters. While participant randomized to the MST intervention did not perform better, examination of the cognitive mental fitness skills data and the physiologic reactivity and recovery suggests there may be improvement in imagery, mental practice, focus/refocus, and competition planning as well as differences in physiologic regulation attributable to the training. There also appear to be individual differences associated with the magnitude of the physiological responses. **Implications for Military Nursing**: The findings suggest MST may be a useful to improve mental skills fitness and physiologic regulation in Army Nurses exposed to unpredictable, chaotic, and complex situations.

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performance, stress, biomarker, military deployment

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Principal Investigator (PI) Military Contact Information Duty Title	
Address	
Telephone	
Mobile Telephone	
E-mail Address	

PI Home Contact Information

Address	
Telephone	
Mobile Telephone	
E-mail Address	

Signatures

PI Signature _____ Date _____

Mentor Signature _____ Date _____

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Abstract

Purpose: To test the feasibility and determine the effect size of using a Mental Skills Training (MST) intervention to improve performance of Army Nurses in a simulated Combat Casualty Stress Scenario (CCSS) and explore the relevance of individual differences in performance, behavioral response and physiologic response to the stressor.

Design: The study used a randomized, controlled, blinded design using repeated measures design to test the procedures, measures, and a simulated scenario needed to evaluate the effectiveness of ACEP training on nurse performance under stress.

Methods: The intervention group received 16 hours of MST and the control group continued to work and train on their assigned nursing units. The CCSS employed a combination of medical triage, treatment and implementation of common soldier skills. Before, during, and after the 10 minute CCSS, salivary alpha amylase and cortisol were collected; blood pressure and heart rate were also recorded.

Sample: A convenience sample of 38 Army Nurses from Madigan Army Medical Center volunteered to participate in the study.

Analysis: Descriptive statistics, repeated measures analysis of variance, Pearson's correlation, and both paired an independent t tests were used to examine the data.

Findings: Results suggest the CCSS is an effective stressor, with large magnitude increases in all physiologic parameters. While participant randomized to the MST intervention did not perform better, examination of the cognitive mental fitness skills data and the physiologic reactivity and recovery suggests there may be improvement in imagery, mental practice, focus/refocus, and competition planning as well as differences in physiologic regulation attributable to the training. There also appear to be individual differences associated with the magnitude of the physiological responses.

Implications for Military Nursing: The findings suggest MST may be a useful to improve mental skills fitness and physiologic regulation in Army Nurses exposed to unpredictable, chaotic, and complex situations.

TSNRP Research Priorities that Study or Project Addresses

Primary Priority

Force Health Protection:	☐ Fit and ready force ☐ Deploy with and care for the warrior ☐ Care for all entrusted to our care
Nursing Competencies and Practice:	☐ Patient outcomes ☐ Quality and safety ☐ Translate research into practice/evidence-based practice ☐ Clinical excellence ☐ Knowledge management ☐ Education and training
Leadership, Ethics, and Mentoring:	☐ Health policy ☐ Recruitment and retention ☐ Preparing tomorrow's leaders ☐ Care of the caregiver
	☒ Military Deployment

Secondary Priority

Force Health Protection:	☐ Fit and ready force ☐ Deploy with and care for the warrior ☐ Care for all entrusted to our care
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Leadership, Ethics, and Mentoring:	☐ Health policy ☐ Recruitment and retention ☐ Preparing tomorrow's leaders ☐ Care of the caregiver
Other:	☐

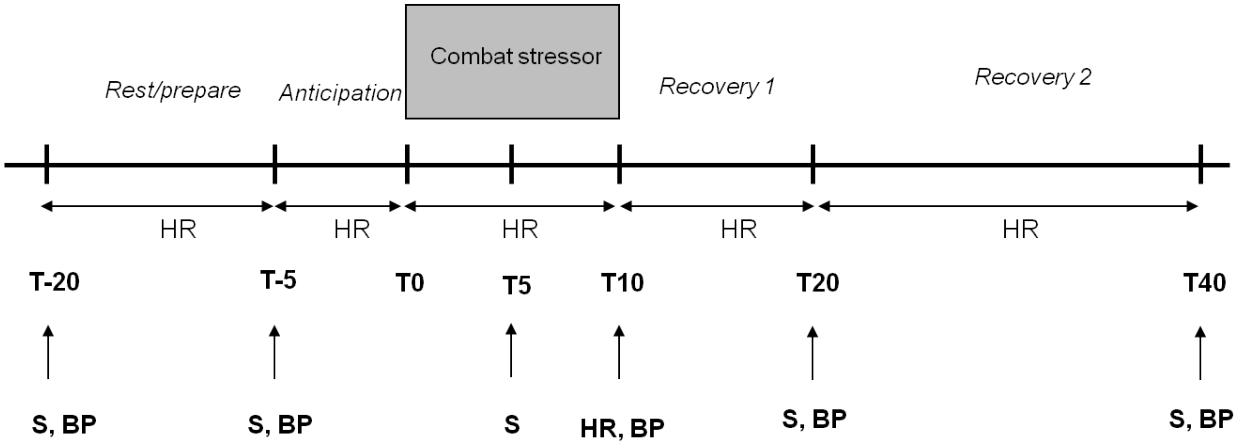
Progress Towards Achievement of Specific Aims of the Study or Project

Findings related to each specific aim, research or study questions, and/or hypothesis
The *primary aim* of this pilot study was to test the feasibility of using the 16-hour ACEP training course as an intervention to improve performance under a simulated combat environment in novice Army Nurses with no combat exposure. We proposed to evaluate implementation of the ACEP training and explore relationships between the ACEP training exposure and performance in a simulated Combat Casualty Stress Scenario (CCSS). Feasibility testing included:

Assessment of the CCSS as an effective stressor

The time points of the CCSS are illustrated in **Figure 1**. The preliminary findings suggest that the CCSS was rated similarly stressful by all participants, and indeed, both the treatment and control group rated their perceived stress during the CCSS similarly (**Table 1**). More importantly, examination of the physiologic response in aggregate suggests that the CCSS is an effective stressor and participation in the combat casualty simulation was associated with increased levels of peripheral indices of the HPA axis and ANS (**Figures 2, 3, & 4**). Acute physiological reactivity was followed by recovery to pre-task baseline levels for all ANS measures, although for most of these measures it took at least 30 minutes after the CCSS completion to return to baseline. Salivary cortisol remained elevated over pre-task levels 30 minutes after the conclusion of the task.

Figure 1 Overview of the Combat Casualty Stress Scenario



HR=heart rate; S=salivary biomarker collection; BP=blood pressure assessment

Table 1 Visual Analogue Scale Self Assessment (0-100mm) of Perceived Stress, Performance & Difficulty between intervention (MST) and control group (no MST)

	MST (n=19)	No MST (n=19)	*p*
Perceived stress (mm)	59.8 (18.0)	58.5 (22.7)	.84
Perceived performance (mm)	50.1 (29.3)	55.4 (28.2)	.61
Perceived difficulty (mm)	50.0 (24.1)	49.5 (20.4)	.95

In the 35 participants with complete data, repeated measures ANOVA for sAA revealed a significant main effect of time, F (3.14, 118.83) = 9.87, $p < .01$ (**Figure 2**). Contrasts indicated that sAA levels increased significantly from baseline to the anticipation phase ($p < .01$) and from the anticipation phase to the mid-CCSS assessment ($p < .01$). The increase in sAA levels from baseline to the mid-CCSS assessment was more than 10% for 29 nurses (83%), and they showed an average increase of 125%. Twenty minutes after the start of the CCSS, sAA levels were significantly lower compared to the mid-CCSS assessment ($p < .01$), and there were no longer any significant differences with baseline levels of sAA ($p = .12$).

In the 33 participants with complete data, repeated measures ANOVA for salivary cortisol revealed a significant effect of time, F (1.92, 61.39) = 10.65, $p < .01$ (**Figure 2**). There were no significant differences in cortisol levels between the baseline and anticipation phase ($p = .33$). However, cortisol levels at the mid-CCSS assessment were significantly higher compared to baseline ($p = .03$) and continued to increase until 20 minutes after the CCSS ($p < 01$). Forty minutes after the CCSS, there was a significant decrease in cortisol levels compared to the previous assessment ($p < .01$) but cortisol was still significantly higher compared to baseline levels ($p < .01$).

The repeated measures ANOVA for heart rate (HR) included 37 participants, and again, the repeated measures ANOVA revealed a significant effect of time, F (1.87, 67.36) = 363.64, $p < .01$ (**Figure 3**). Heart rate increased significantly from baseline to the anticipation phase ($p < .01$), continued increasing during the CCSS ($p < .01$), followed by a significant decrease in each subsequent phase (p's $< .01$). Forty minutes after the CCSS, participant's HRs were no different from baseline ($p = .42$).

Finally, for systolic blood pressure (SBP) and diastolic blood pressure (DBP) the repeated measures ANOVAs included 38 participants and demonstrated a significant main effect of time, for both SBP, F (2.74, 101.39) = 45.21, $p < .01$ and DBP, F (3.29, 121.89) = 21.37, $p < .01$ (**Figure 4**). Both SBP and DBP increased from baseline to the anticipation phase (p's $< .01$), but no significant differences in SBP and DBP before and immediately after the CCSS ($p = .77$ and $p = .17$, respectively) were identified. Twenty minutes after the CCSS, there was a significant decrease in SBP and DBP when compared to the assessment immediately after the CCSS (p's $< .01$) and both continued to decrease (p's $< .01$). There were no differences between SBP and DBP from baseline levels 20 minutes after the CCSS and 40 minutes after the CCSS.

Figure 2 Cortisol and salivary α-amylase (sAA) [transformed] in response to the Combat Casualty Stress Scenario

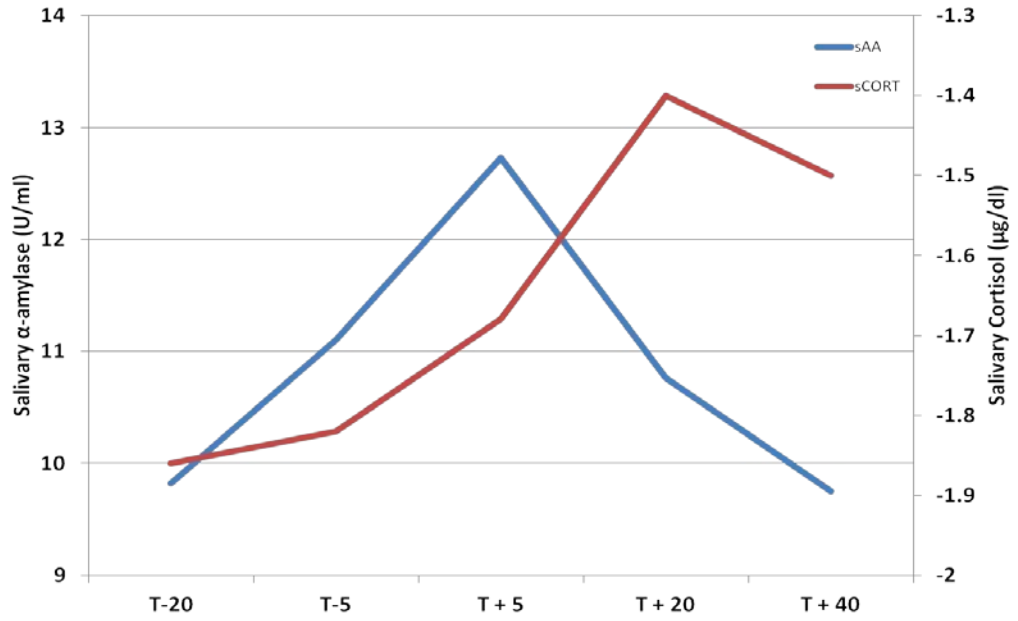


Figure 3 Heart rate response to the Combat Casualty Stress Scenario

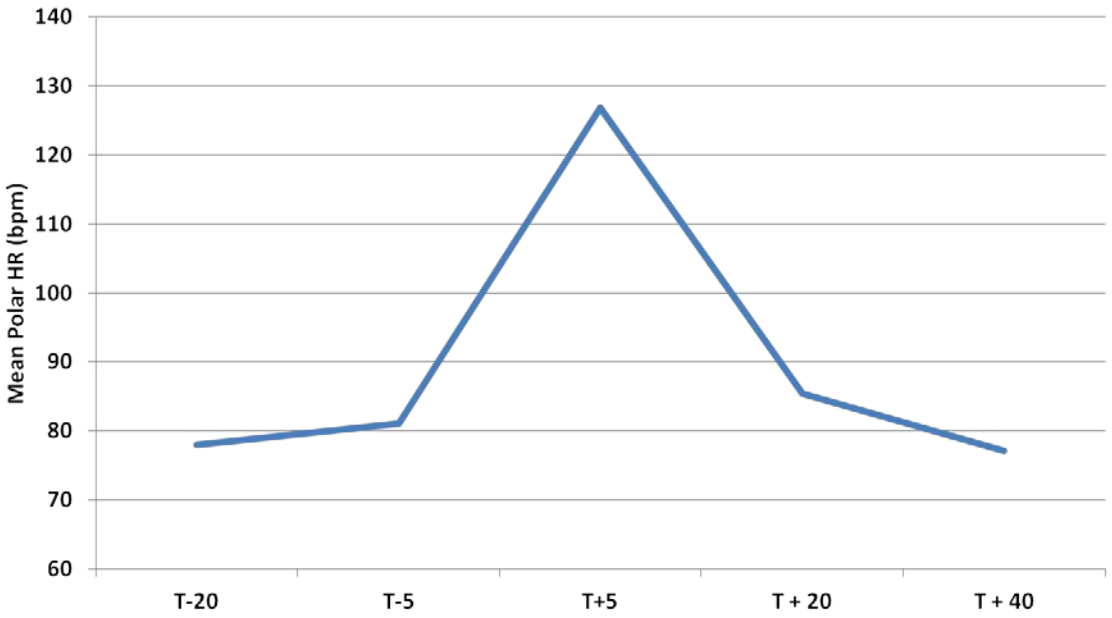
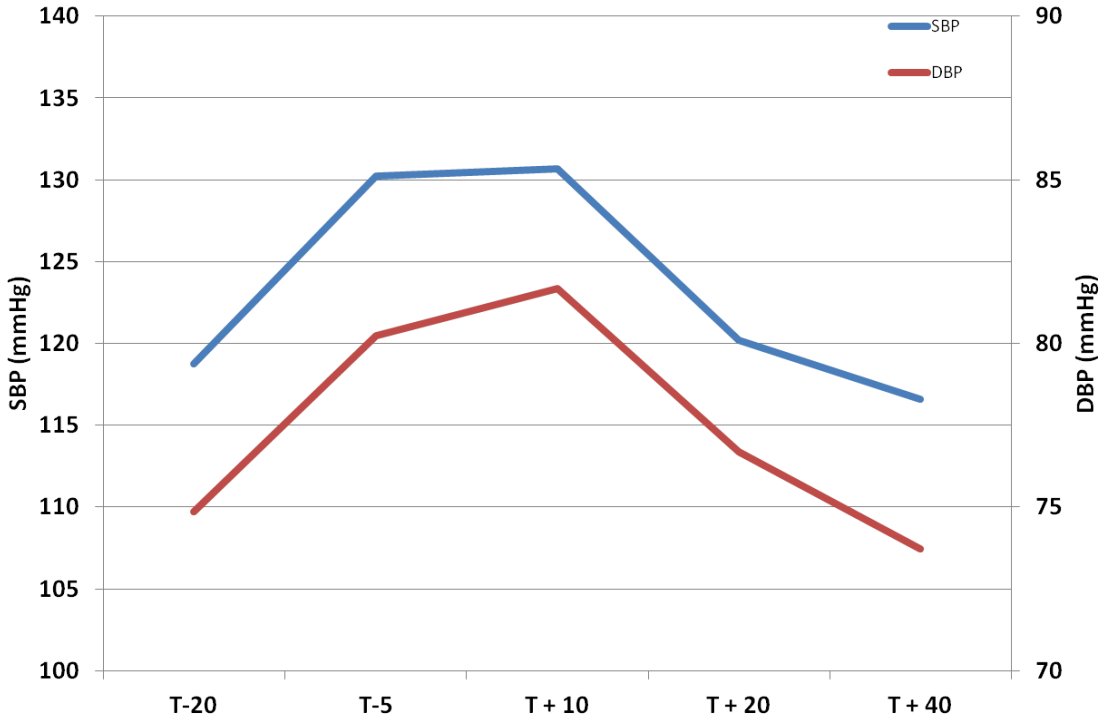


Figure 4 Systolic and blood pressure in response to the Combat Casualty Stress Scenario



SBP = systolic blood pressure. DBP = diastolic blood pressure

Determination of the effectiveness of randomization

Based on the non-significant comparisons between dichotomous and continuous variables that may affect the physiologic response, including salivary alpha amylase, salivary cortisol, and blood pressure and heart rate, it is apparent that the randomization strategy was effective (**Table 2**).

Table 2 Characteristics of Participants randomized to the Intervention Group (Mental Skills Training [MST]) and Control Group (no MST)

	MST (n=19)	No MST (n=19)	p
Age (years)	28.6 (SD=6.3)	28.5 (SD=6.8)	.98
Deployment history (%)	16	33	.25
Female (%)	74	74	1.0
APFT Score (maximum 300)	249 (SD=46)	245 (SD=57)	.83
ROTC/USMA Commission Source (%)	33	53	.24
Positive Depression Screen (%)	11	11	1.0
Positive Anxiety Screen (%)	11	11	1.0

APFT: Army Physical Fitness Test; ROTC: Reserve Officer Training Corps; USMA: United States Military Academy

Assessment of the relevance of specific measurement tools in Army Nurses

Reliability coefficients were calculated on the measurement tools (**Table 3**). Additionally, performance was evaluated by simulation center medical staff with combat experience and who routinely engage in evaluations for a number of military requirements/missions. Task completion employed standards for Common Soldier Task evaluation and with which the grader was familiar. Scores were based on treatment of gunshot wound (possible 117 points), treatment of traumatic left lower extremity amputation (possible 122 points) and calling a 9-line medical evacuation order (4 points). Performance objectives related to the casualties included (1) proper conduct of preliminary assessments for the patient; (2) accurate triage based on injury severity; (3) initiation of treatment, (e.g., occlusive dressing application to the gunshot wound and application of the combat application tourniquet to the traumatic lower extremity amputation). For 27 nurses, video recordings of each session were reviewed and performance scored by another simulation center medical staff member who had combat experience. Intraclass correlation coefficient was .74 for the amputation patient, and .55 for the chest wound patient. While not ideal, moderate-strong correlations between rater's performance scores for the chest patient (r=.58, p=.001) and the amputation patient (r= .73, p<.001) were identified; additionally, paired t test results did not indicate significant differences between rater's chest patient and amputation patient performance scores (p=.87, .29, respectively).

Table 3 Reliability coefficients of measurement tools

Measurement Tool	Reliability
Conner Davidson Resilience Inventory	.94
Intrinsic Motivation Inventory	.78
Ottawa Mental Skills Assessment Test-3	.79
Spiritual Well Being Scale	.94
Rosenberg Self Esteem Scale	.91
Beck Hopelessness Scale	.80*
Brief Symptom Inventory	.94
Perceived Stress Scale	.90

*KR-20 used to determine reliability coefficient

Refinement of procedures to quantify an objective physiological response to stress

Prior to implementation of the protocol, the study team met at Joint Base Lewis McChord, WA. The purpose of the team meeting was to introduce all team members and foster a collaborative approach to the conduct of the study. In addition, the team engaged in (1) discussion of salivary biomarkers; (2) MST overview; (3) Medical Simulation Training Center orientation; (4) a walk through and "dress rehearsal" of the CCSS; and (5) a discussion of a study timeline and dissemination activities. Due to the complexity of the protocol and the consistency required between study staff to ensure samples were obtained in a uniform manner, it was decided that a prerecording a script on an MP3 player for use from the beginning of the CCSS through the conclusion of the CCSS would be beneficial. The recording included preemptive cues and explicit prompts for preparing participants for the sequence of events, including patient movement, blood pressure assessment, salivary oral swab (SOS) preparatory directions, SOS placement, and SOS removal. After the first CCSS, selected videos were reviewed for timing of SOS placement during the CCSS and discussed among study staff with minor adjustments made

to ensure the SOS remained under the tongue for a sufficient length of time. Rather than relying on observation of a fragmented "dress rehearsal" that included discussion points and clarification, in future studies, recommendations for validation of biomarker collection is essential for all study staff. Observation during a complete and seamless "dress rehearsal" will validate the collection times and increase the comfort level of staff collecting the specimens and obtaining the measurements.

Determination of minimal detectable effect sizes that will help design a larger study

Key comparisons between performance in the CCSS (**Table 4)** and specific points of reactivity and recovery in the protocol used to determine effect sizes for a larger study are listed in **Table 5**. The performance scores are separated into three groups because there were clear distinctions between groups and differences from the first cohort of novice nurses: first, one of the novice groups was exposed (i.e., contamination) to IFAK training and second, the final group of nurses had both nursing and deployment experience.

Clearly, the small effect size of salivary alpha amylase reactivity makes conducting a study of such a large magnitude prohibitive. It is unfortunate that in the study design, we did not include methods to assess the continued application and sustainment of the strategies taught in the MST intervention; indeed, the small effect size of the salivary alpha-amylase may not reflect the intervention per se, but rather the failure of participants to engage in sustainment strategies for the newly acquired skills. On the other hand, we identified a moderate effect size for several other variables.

Table 4 Performance scores between intervention (MST) and control (no MST) groups

Cohort	MST	No MST	*p*	Effect size (Cohen's d)	Group size (2 group β=.80, α=.05)
No IFAK exposure					
Novice Nurses	9	11			
Performance Score	75.9 (56.5)	55.7 (31.5)	.31	.44	83
Novice-IFAK exposure					
Novice Nurses	5	5			
Performance Score	87.2 (39.3)	126.2 (57.1)	.24	.78*	-
Deployment/Nursing Experience					
Experienced Nurses	5	3			
Performance Score	109.0(47.7)	131.0 (32.2)	.46	.54*	-

Figures 5 through 8 illustrate the physiologic response between the intervention (MST) and control groups (no MST). For cortisol, 33 participants were included in the repeated measures ANOVA, which revealed a significant effect of time, F (1.90, 59.03) = 10.59, $p < .01$, no significant effect of MST F (1, 31) = .001, p = .98 or time x MST, F (1.90, 59.03) = .54, p = .58 (**Figure 5**). The analysis suggests that the intervention group had a more pronounced cortisol recovery between the peak cortisol in Recovery 1 and the final collection in Recovery 2 (p=.11). The repeated measures ANOVA for sAA included 35 participants with complete data. There was a significant main effect of time, F (3.14, 103.73) = 9.78, $p < .01$, no significant effect of MST F (1, 33) = 1.89, p = .18 or time x MST, F (3.14, 103.73) = .78, p = .51 (**Figure 6**). Contrasts

between previous levels did not indicate significant differences between groups. The repeated measures ANOVA for HR included 38 participants. There was a significant effect of time, F (1.83, 65.74) = 413.55, $p < .01$, no significant effect of MST F (1, 36) = 1.55, $p = .15$ or time x MST, F (1.83, 65.74) = 2.0, $p = .15$ (**Figure 7**). The analysis suggests that the intervention group had a marked heart rate recovery between Recovery 1 and Recovery 2 (p=.10). For blood pressure the repeated measures ANOVAs included 38 nurses and indicated a significant main effect of time, for SBP, F (2.68, 96.31) = 45.08, $p < .01$ and MST F (1, 36) = 4.83, $p = .03$ with no significant effect for time x MST, F (2.68, 96.31) = .89, $p = .44$ (**Figure 8**). For DBP, there was a significant main effect of time, F (3.22, 116.08) = 21.86, $p < .01$ and a marginal effect of MST (1, 36) =3.69, p=.06 with no significant effect for time x MST, F (3.22, 116.08) = 1.85, p= .14 (**Figure 8**).

Table 5 Physiologic response in the Combat Casualty Stress Scenario between intervention (MST) and control (no MST) groups

Physiologic Response	MST	No MST	*p*	Effect size (Cohen's d)	Group size (2 group β=.80, α=.05)
Alpha-amylase Reactivity (baseline-anticipation)	49.6 (111.4)	31.6 (46.5)	.53	.21	354
Alpha-amylase Peak Reactivity (baseline-midstressor)	92.4 (108.0)	79.6 (75.6)	.69	.14	838
Alpha-amylase Maximum Recovery (midstressor-recovery 2)	-44.0 (27.2)	-31.3 (43.1)	.32	.36	126
Cortisol Peak Reactivity (baseline-recovery 1)	76.9 (102.8)	59.6 (79.9)	.58	.19	450
Cortisol Maximum Recovery (recovery 1-recovery 2)	-14.5 (18.5)	-3.4 (19.5)	.08	.59	47
Heart Rate Peak Reactivity (baseline-midstressor)	60.7 (18.5)	70.0 (21.4)	.16	.47	74
HR Maximum Recovery (2) (midstressor-recovery 2)	-39.4(5.6)	-39.4 (6.2)	1.0	0	-
SBP Peak Reactivity (baseline-post-stressor)	8.9 (6.1)	11.7 (7.3)	.21	.42	91
SBP Maximum Recovery (2) (post-stressor-recovery 2)	-10.8 (5.0)	-10.6 (4.5)	.88	.04	9813
DBP Peak Reactivity (baseline-post-stressor)	7.5 (5.2)	12.0 (13.1)	.17	.45	78
DBP Maximum Recovery (2) (post-stressor-recovery 2)	-10.8(5.4)	-8.5 (10.4)	.40	.28	202

Figure 5 Cortisol [ln transformed] response to the Combat Casualty Stress Scenario between intervention (MST) and control (no MST) groups

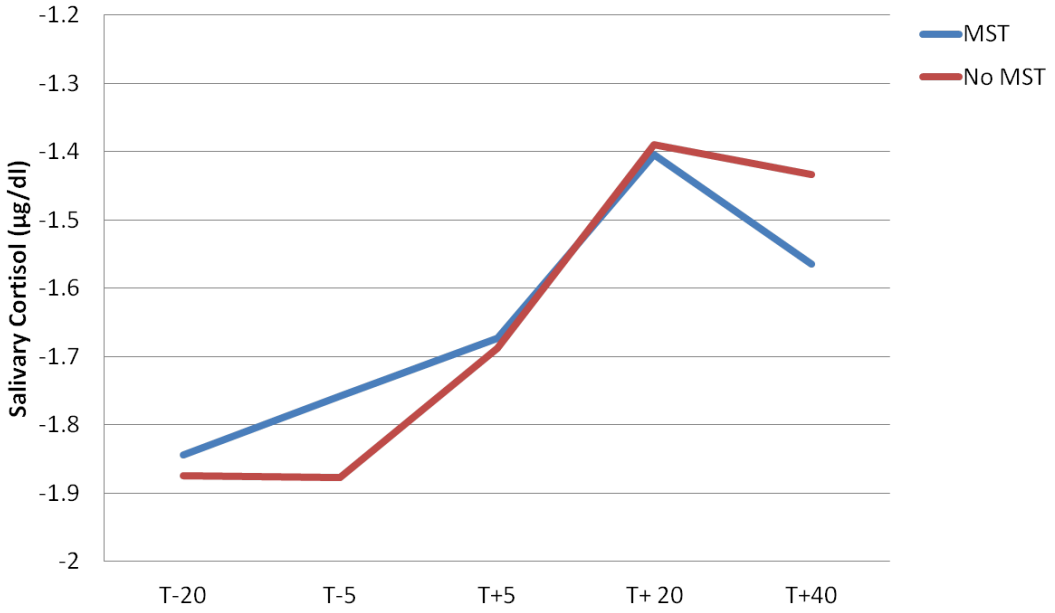


Figure 6 Salivary alpha-amylase [sqrt transformed] response to the Combat Casualty Stress Scenario between intervention (MST) and control (no MST) groups

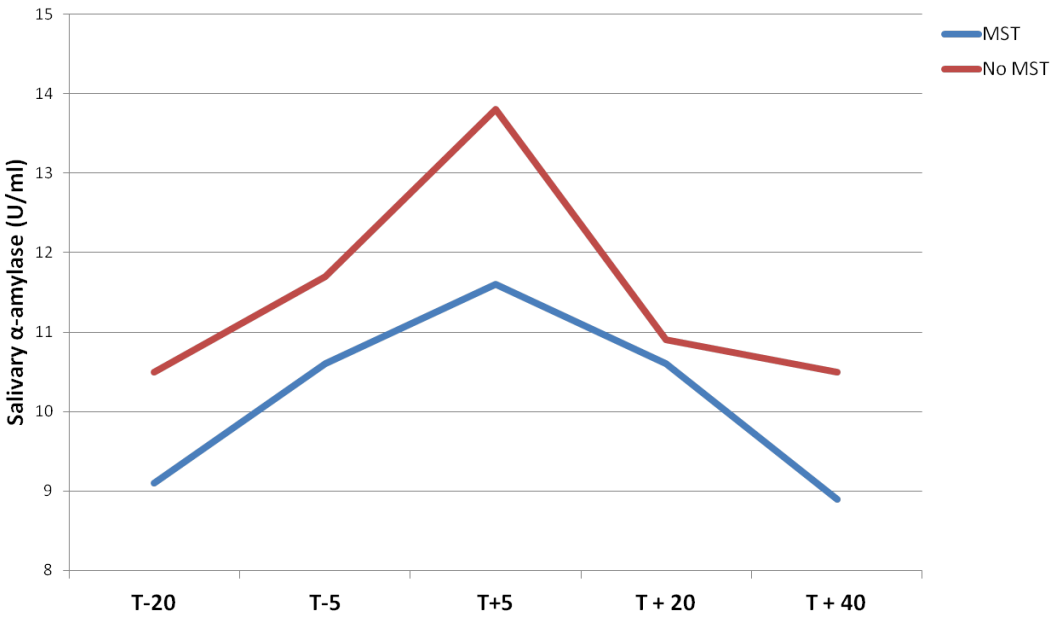


Figure 7 Heart rate response to the Combat Casualty Stress Scenario between intervention (MST) and control (no MST) groups

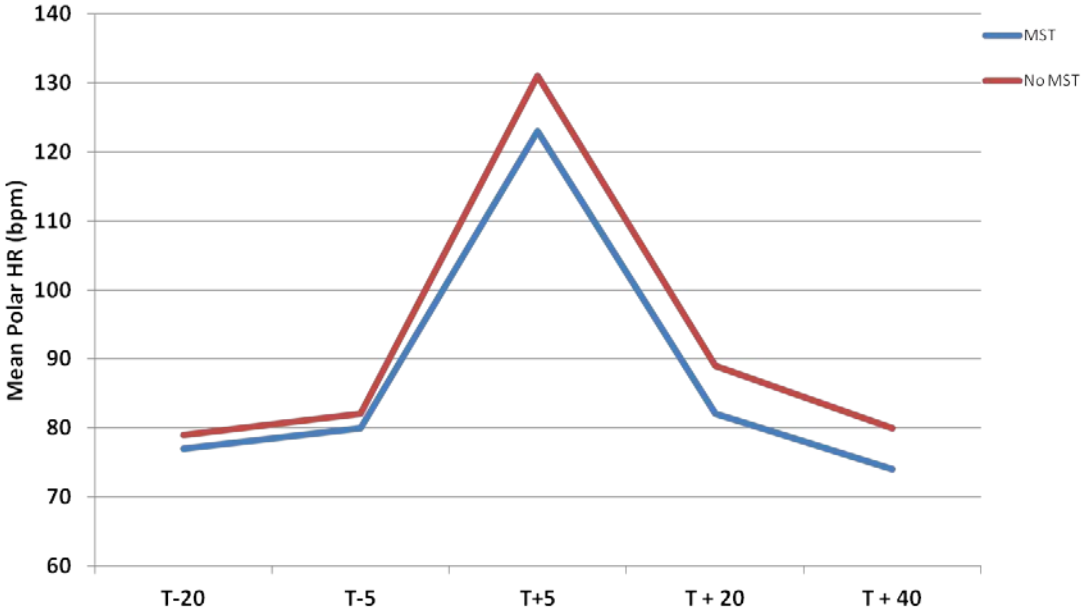
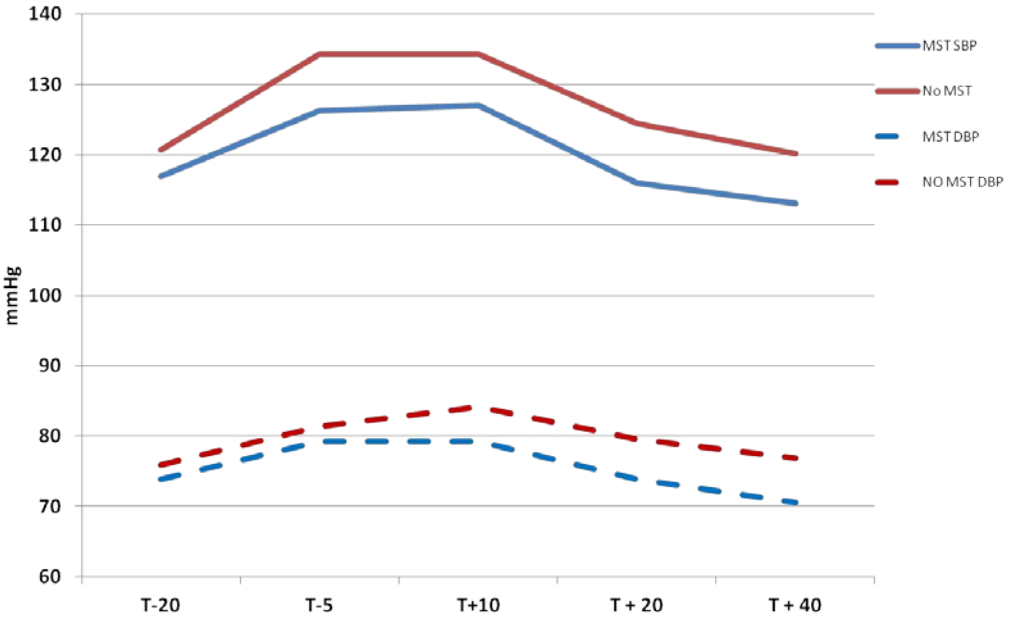


Figure 8 Blood pressure response to the Combat Casualty Stress Scenario between intervention (MST) and control (no MST) groups



Secondary Aims

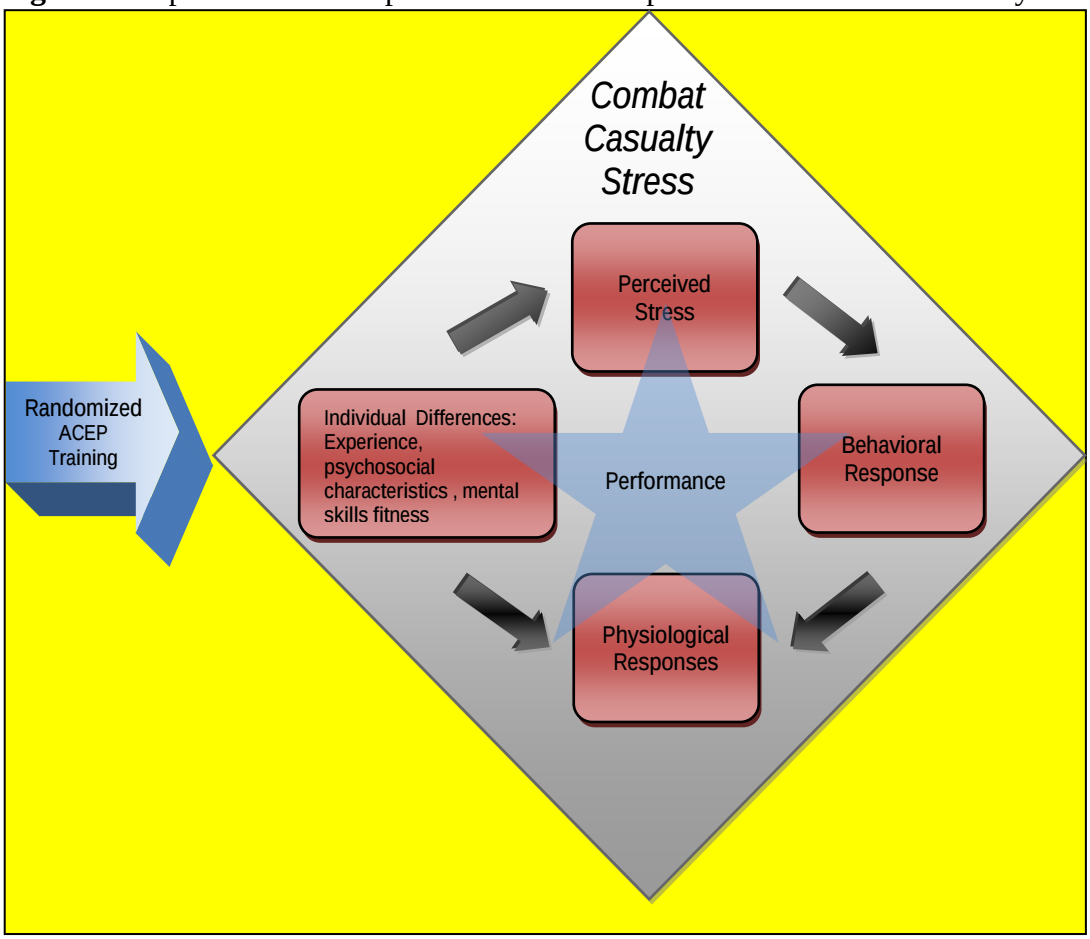
The secondary aims were exploratory in nature and included:

Evaluation of the relevance of variables in a proposed performance model. Exploration of the relationships between mental skills fitness, psychosocial characteristics, physiologic response and performance on the CCSS.

The model proposed for the study is depicted in **Figure 9**. Because of the small sample size, the variables were examined in aggregate and not evaluated based on treatment and control group and a one-tailed test was employed.

Physiological reactivity and recovery: associations between cortisol, sAA, HR and blood pressure Reactivity and recovery indices were significantly associated within each physiological parameter (r = .36 – .89, df = 33 – 36, p's < .03). A greater SBP stress response was associated with a smaller cortisol stress response, r (35) = -.47, p < .01, and with less recovery in cortisol levels, r (35) = -.28, p = .09. Both salivary alpha amylase reactivity and recovery were positively associated with change in HR. Participants with a larger increase in sAA from baseline to mid-CCSS were also more likely to show a larger increase in HR, r (33) = .33, p = .05. In addition, more rapid sAA recovery following the stressor was associated with increased HR responses to the CCSS (r [33] = .43, p = .01) and a more rapid HR recovery afterwards (r [33] = .38, p = .02).

Figure 9 Proposed model for performance and response in the Combat Casualty Stress Scenario



Physiological reactivity and recovery: associations with mental fitness skills and psychosocial characteristics We examined whether mental fitness skills as measured by domains within the Intrinsic Motivation Inventory (IMI), the Ottawa Mental Skills Assessment Test (OMSAT-3), and the Connor-Davidson Resilience Scale (CD-RISC) were related to physiological reactivity and recovery. Additionally, we examined whether psychosocial characteristics as measured by the Rosenberg Self Esteem Scale (RSES), Beck Hopelessness Scale (BH), and the Brief Symptom Inventory (BSI) were associated with the individual differences in the degree of physiological reactivity and recovery to the CCSS. Within the BSI, all domains were significantly related to each other, $r(36)=.292$ - $.738$, $p=.038$ - $<.001$; within the CD-RISC, all the domains were significantly correlated, $r(36)=.280$ - $.875$, $p=.044$ - $<.001$; and within the IMI significant correlations were noted, $r(36)= -.374$ $-.838$, $p=.011$ - $<.001$. The domains in the OMSAT -3 were not as consistently related to one another, and may be a function of the tools' not being translated to military personnel in its entirety. In a previous study, the OMSAT-3 Revised for Soldiers was created based on a factor analysis using over 400 respondents to the OMSAT-3R (Hammermeister, 2010); the small sample size precluded our ability to employ this technique. Given the number of correlations performed between physiological response and mental fitness skills and psychosocial characteristics, they are presented in **Table 6**. It should be noted that it was expected that some variables would bear out statistical significance given the volume of comparisons. In general, scores associated with psychosocial characteristics (e.g., somaticism, anxiety) were related to lower heart rate, systolic blood pressure and diastolic blood pressure reactivity to the CCSS. Given the blunted reactivity, a lower overall recovery is expected for the same variables.

Physiological reactivity and recovery: associations between age, gender and experience We examined if there was a relationship between age, gender and nursing experience and the individual differences in the degree of physiological reactivity and recovery to the CCSS. Older nurses were more likely to show a larger sAA stress response than younger nurses, r (33) = .40, p = .02, but also showed less SBP reactivity and recovery, r (36) = -.42, $p < .01$ and r (36) = -.43, $p < .01$. There were no other significant associations with age. Males (n = 9) showed more changes in their cortisol levels than females (n = 28): they displayed a larger stress response, t (9.44) = -4.19, $p < .01$, and a more rapid recovery, t (35) = -2.76, $p < .01$. In addition, there was a significant difference in SBP recovery between males and females, with more rapid recovery for males, t (36) = -2.22, p = .03. Finally, nurses with nursing and deployment experience (n = 8) tended to show less DBP reactivity (t [36] = 1.85, p = .07) and recovery (t [36] = 2.37, p = .02), compared to novice Army Nurses (n = 30). No other significant associations with nursing experience emerged.

Table 6 Correlation of physiologic response to the Combat Casualty Stress Scenario and mental fitness skills and psychosocial characteristics

Physiologic Response		Mental Fitness Skills and Psychosocial Characteristics
sAA Reactivity	Baseline-Anticipation	**BSI**: Paranoid ideation r(35)=.306, p=.033; Global Severity Index (GSI): r(35)=.287, p=.042
sAA Recovery	Midstressor-recovery 1	**IMI** Competence r(32)= -.296,p=.045
sCORT Reactivity	Baseline-recovery 1	**CDR** Spiritual r(34)= -.352, p=.018; **SWBS** Religiosity r(33)= -.389, p=.011
sCORT Recovery	Recovery 1-Recovery 2	**CDR** Positive r(34)= -.302, p=.037; **SWBS** Religiosity r(33)= .295, p=.043
HR Reactivity	Baseline-Anticipation	**OMSAT-3** Focus r(35)= -.324, p=.025; **BSI**: Somaticism r(35)= -.388, p=.009
	Baseline-midstressor	**IMI**-interest/enjoyment r(35)=.288, p=.042;Effort/importance r(34)=.352, p=.018 **OMSAT-3**: Commitment r(35)= .295, p=.038; Focus r(35)= -.404, p=.007; Foundational skills r(35)=.298, p=.037; **BSI**: Obsessive Compulsive r(35)= -.391, p=.008; Interpersonal Sensitivity r(35)= -.342, p=.019; Hostility r(35)= -.455, p=.002; Paranoid ideation r(35)= -.302, p=.035; Psychoticism r(35)= -.352, p=.016; GSI r(35)= -.433, p=.004
HR Recovery	Midstressor-recovery 1	**IMI**: competence r(34)= -.315, p=.030; effort/importance r(34)= -.312, p=.032 **OMSAT-3**: Goal setting r(35)= -.360, p=.014; Commitment r(35)= -.344, p=.019; Focus r(35)= .360, p=.014; Foundational skills r(35)= -.337, p=.021 RSES r(35)= -.311, p=.030; **BSI**: Somaticism r(35)= .318, p=.028; Obsessive Compulsive r(35)= .317, p=.028; Interpersonal Sensitivity r(35)=.371, p=.012; Anxiety r(35)=.313, p=.030; Hostility r(35)= .356, p=.015; Paranoid ideation r(35)= .299, p=.036; Psychoticism r(35)= .401, p=.007; GSI: r(35)= .448, p=.003
	Midstressor-recovery 2	**IMI**: effort/importance r(33)= -.348, p=.020; **OMSAT -3**: Goal setting r(34)= -.296, p=.040; Commitment r(34)= -.388, p=.010; Focus r(34)= .361, p=.015; Foundational skills r(34)= -.332, p=.024; **RSES** :r(34)= -.302, p=.036; **BSI**: Obsessive Compulsive r(34)= .498, p=.001; Interpersonal Sensitivity r(34)=.329, p=.025; Anxiety r(34)=.322, p=.028; Hostility r(34)= .423, p=.005; Paranoid ideation r(34)= .278, p=.050; Psychoticism r(34)= .366, p=.014; GSI: r(34)= .510, p=.001
SBP Reactivity	Baseline-Anticipation	**IMI:**effort/importance r(35)=-.288, p=.042;**OMSAT-3**: Goal setting r(36)= .367, p=.012;Foundational skills r(36)= .292, p=.038;**BSI**:Somaticism r(36)=- .281,p=.044
	Baseline-post-stressor	**BSI**: Paranoid ideation r(36)= .368, p=.011
SBP Recovery	Post-stressor -recovery 1	**OMSAT-3**: Commitment r(36)= -.322, p=.024; Foundational skills r(36)= -.279, p=.045; **BH**: r(36)=.364, p=.012
DBP Reactivity	Baseline-Anticipation	**OMSAT-3**: Refocus r(35)= -.380, p=.010; Competition Planning r(35)=.290, p=.039; **BSI:** Somaticism r(36)= -.316, p=.027
	Baseline-post-stressor	**OMSAT-3**: Stress Reaction r(36)= -.308, p=.030; Refocus r(35)= -.467, p=.002; Competition Planning r(36)=.274, p=.048; **BSI**: Anxiety r(36)= -.286, p=.041; Paranoid ideation r(36)= -.339, p=.019; Positive Symptom Distress Index r(36)=.374, p=.010
DBP Recovery	Post-stressor-recovery 1	**OMSAT-3**: Refocus r(35)= .297, p=.037; Competition Planning r(36)= -.273, p=.049; **BSI**: Anxiety r(36)=.386, p=.008; Global Severity Score r(36)= .301, p=.033; Positive Symptom Distress Index r(36)= -.369, p=.011
	Post-stressor-recovery 2	**OMSAT-3**: Refocus r(35)= .441, p=.003; Competition Planning r(36)= -.305, p=.031;**BSI**: Anxiety r(36)=.350, p=.016; GSI: r(36)= .272, p=.049

BSI=Brief Symptom Inventory; IMI=Intrinsic Motivation Inventory; OMSAT-3=Ottawa Mental Skills-3;SBP=Systolic blood pressure; DBP=Diastolic blood pressure; HR=Heart rate; sAA=salivary alpha amylase; sCORT=salivary cortisol

Physiological reactivity and recovery: associations with perceptions and performance Regarding assessments on a 100mm visual analogue scale (VAS) after the CCSS, self-rated perceived stress was associated with self reports of perceived performance $r(36)=.332$, $p=.021$ and perceived task difficulty $r(36)=.46$, $p=.002$. We examined whether physiological reactivity and recovery were associated with nurses' perceptions of their stress levels, their performance and the difficulty of the task. Perceived task-related stress was associated with increased HR reactivity and recovery (r [36] = .28, p = .04, and r [36] = .38, p = .01). For perceived performance, participants with a larger increase in cortisol in response to the CCSS were less likely to indicate that they performed well on the task (r [35] = -.30, p = .03). Participants who indicated that the task was difficult displayed less recovery in terms of SBP (r [36] = -.28, p = .05) and sAA (r [33] = -.39, p = .01).

We explored whether the continuous measures for task-specific performance were associated with any of the reactivity and recovery indices. For cortisol, rapid recovery but not reactivity was associated with enhanced performance for the patient with the chest wound, r (35) = .29, p = .04. In addition, two marginally significant correlations for sAA suggest that increased reactivity (r [33] = -.25, p = .07) and a rapid recovery (r [33] = -.24, p= .08) were associated with lower performance for this patient. No significant associations were found for performance with respect to the amputation patient.

Independent *t*-tests confirmed the association between cortisol/sAA reactivity and recovery and performance. Specifically, for the patient with the chest wound, nurses with lower performance scores had significantly less cortisol recovery (t [35] = -2.06, p = .02) compared to nurses with higher performance scores. In addition, nurses with lower performance scores displayed a larger sAA stress response (t [33] = 2.23, p = .02) and tended to show a more rapid sAA recovery following the combat stressor (t [33] = 1.36, p = .09) compared to the other nurses. We subsequently examined the possibility that the rapid sAA recovery for nurses with low performance scores was due to their increased stress response, i.e. they were more likely to show a decrease in sAA levels following the CCSS compared to the other nurses. Indeed, when correcting for initial levels (sAA assessed during the combat stressor), the difference in sAA recovery between nurses with low and high performance scores was no longer significant (p = .16). Finally, there was a tendency for nurses with enhanced performance to show a more rapid recovery in terms of DBP (t [36] = 1.44, p = .08) and HR (t [28.42] = 1.57, p = .06). For the other patient with a traumatic left lower extremity amputation, significant differences were only observed for SBP reactivity, with nurses with higher performance scores showing a smaller stress response than nurses with lower scores (t [36] = 1.79, p = .04).

Performance: Associations with mental fitness skills and psychosocial characteristics We examined whether mental fitness skills as measured by domains within the IMI, the OMSAT-3, and CD-RISC, and psychosocial characteristics as measured by the RSES, BH, and the BSI were associated with performance. Only two characteristics were associated with performance on only the score for the amputation patient: a positive association with paranoid ideation (r[36]=.291, p=.038) and an inverse relationship with the interest/enjoyment domain on the IMI (r[36]= -294, p=.037).

Exploration of relationships between performance and physiologic response to the CCSS in participants randomized to ACEP training and individuals in the control group.

The differences and effect sizes of performance between groups is reflected in **Table 4**, separated by what is believed to be two important distinctions from the original group: first, exposure to IFAK training and second, nursing and deployment experience of the nurses. The salivary alpha-amylase, cortisol, heart rate, systolic blood pressure and diastolic blood pressure are illustrated in **Table 5**.

Exploration of differences in pre and post ACEP training perceived stress, difficulty or performance between the intervention and control group.

As previously discussed, there was no difference between participants perceived stress, difficulty, or performance between the intervention and control group (**Table 1**). Additionally, we assessed baseline stress using the Perceived Stress Score (PSS) at the time of recruitment, and administered the PSS approximately 4 weeks after the MST. For participants randomized to the control group, the PSS was administered 4 weeks after baseline. No differences were noted at baseline or in post-intervention scores (**Table 6**). Repeated measures ANOVA did not show a main effect for MST $F(1,36) = 1.24$, $p=.27$ on PSS. Controlling for novice versus experienced nurse did not alter the findings.

Table 6 Comparison of baseline and post-training Perceived Stress Scale between intervention (MST) and control (No MST) groups

	MST (n=19)	**No MST (n=19)**	**p**
Baseline PSS	19.8 $\pm$ 8.8	17.2 $\pm$ 7.4	.34
Post MST (4 weeks)	18.0 $\pm$ 7.2	15.8 $\pm$ 6.2	.32

Relationship of current findings to previous findings

This was a feasibility pilot study with the primary aim of the study to refine procedures and collect data to determine an effect size for a future study. Despite this, several findings are noteworthy in comparison to other studies.

The intent of MST was to improve mental skills fitness, under the premise that the skills were trainable. What we failed to account for in this study was whether the participants randomized to the intervention group actually used the skills they acquired in the two day training, which will be an important lesson learned for a larger study. As noted in a previous study by the team (Hammermeister, 2010), we identified that performance on the Army Physical Fitness Test are greater in those with inherently strong mental fitness skills profiles when compared to those in the weak mental fitness skills or what we classified as the "fearful/focus" group.

It was interesting to note the correlation between performance and paranoid ideation scores. It may be plausible that a fear of failure or a fear of not having achievements recognized by others drives individuals to overachieve. In the case of the inverse relationship between interest/enjoyment of being a Soldier and performance, this is consistent with what may be seen in the target population because most of the participants were novice Army Nurses with less than

12 months experience. The occupation is new for them and interest/enjoyment is expected, but given the short duration of their time as an Army Nurse, it is reasonable to see lower performance scores.

The skills taught for participants in the intervention group were designed to enhance the components that make up the strong mental skill profile, (e.g., imagery, goal setting, confidence), however, we only had post-MST OMSAT-3 scores for one-half of the sample. There were no statistically significant differences in pre and post intervention scores in the three over-arching domains of the OMSAT-3 (psychosomatic, cognitive, foundational skills), though given the small sample size for this sub-analysis, it would be very unlikely to detect differences. There was, however, one finding worth mentioning. For the cognitive skills domain, there was no main effect for time (F [1, 15] =.59, p=.46) or MST (F [1, 15] =.02, p=.89), but the findings of the interaction term, time x MST (F [1, 15] =1.70, p=.21) suggests an improvement in the MST group. This finding deserves further exploration in a larger study and though this finding is optimistic, it is unclear whether the mental skills can be trained in an individual to strengthen their baseline mental skills characteristics and whether this training alone, i.e., without continued and verified practice, is beneficial to an individual's overall performance or the individual's physiologic response. To this end, the subsequent grant proposal included methods to capture not only the application of strategies taught, but also whether the maintenance of skills, specifically through biofeedback, is effective. Additionally, while it appears the participant in the MST intervention group may have been able to better regulate their physiologic stress reactivity and recovery, it is important to be able to assess a "dose effect" in these circumstances by having participants track their level of engagement with mental fitness skills. Indeed, the theoretical perspectives of McEwen (McEwen, 2008), Gottlieb (Gottlieb, 1992), and Weiner (Weiner, 1992) suggest that previous experience and training potentially moderate the psychobiology of the stress response in these types of circumstances. Future research is needed to explore how much and what types of training experiences are required to exceed the threshold needed to empower individuals with the skills and schemas, and enable quick recall and deployment of those tools when exposed to stressful circumstances that may develop or enhance resilience.

The magnitude and consistency of the physiologic responses is impressive. The effect size of these observations in the simulation task implies that the magnitude and breadth of the response (height of peak reactivity, and duration of recovery) to the CCSS may be more pronounced to actual combat experiences or management of critically injured patients in theater, and further supports the importance of optimal performance in stressful circumstances. Our findings underscore that there are substantial physiological consequences for individuals who encounter these complex and chaotic environments. The literature leads us to believe that the confluence of several characteristics of the CCSS simulation influence the magnitude of the stress response as the nurses work to achieve the objectives (Wiener, 1992). First, there are no alternative response options. Unable to "escape" the stress by leaving the scene, it is very clear that action is required by the sole responder to resolve the situation, with no possibility of diffusing responsibility for the success of the rescue. The pioneering work by Selye in animal models suggests that physiological reactivity is likely to be maximal when the environmental challenge is high intensity, long duration, and the individual has no behavioral response options (Selye, 1998/1936). Second, the outcome is uncertain. Stakes are very high and time urgency dictates

immediate and appropriate action or the “patients” will die. Finally, there is a clear performance evaluation component. If a mistake is made, there is no question it is this individual’s "fault" or “failure”.

The association between individual differences in physiological reactivity, and recovery, and performance has important implications. Observations that HPA and ANS reactivity is related to performance deficits during a high intensity challenge are consistent with Henry’s (1992) model of the biological stress response, as well as with empirical findings from studies focusing on similar settings (Taylor, et al., 2007), including performance of soldiers in survival training (Morgan, et al., 2004) and cognitive testing of elite US military officers engaged in simulated combat conditions (Lieberman, et al., 2005). The novel finding in this study is that poor task-specific performance was associated with delayed cortisol recovery. Anecdotal evidence suggests that the nurses spend time after triage-treatment events rethinking what has happened and ruminating about what they did or did not do correctly, and how they should have done things differently. It is possible that rumination is linked to prolonging the experience, amplifying negative affective states, and extending HPA activity well beyond the termination of the proximal features of the event itself (Byrd-Craven, Geary, Rose, & Ponzi, 2008; Pieper, Brosschot, van der Leeden, & Thayer, 2010). The role of stress-related glucocorticoids in encoding long-term memory, and negative emotional memories in particular, raises the possibility that nurses who experience these types of events would relive these events multiple times in the future. If triage-treatment events were experienced repeatedly, as happens in the current theater of operations, it is conceivable that a viscous cycle is perpetuated, resulting in negative carry-over of experiences from earlier to later events.

The aspect of religiosity and spirituality is an interesting variable that is associated with a lower peak cortisol response, and the association between religiosity and stress response is consistent with previous work examining stress exposure and cortisol response (Tartaro, Luecken, & Gunn, 2005). Exploring this relationship further, we examined discordant relationships between individuals who subjectively reported low stress, but had an elevated physiologic response. Spirituality was the only variable that was consistently related to both salivary alpha-amylase and cortisol responses. Analysis of variance with Bonferroni post hoc analysis revealed that in groups with lower subjective stress and higher sAA reactivity had marginally higher religiosity scores than those in the subjective higher stress and lower sAA reactivity (p=.072) . Examination of salivary cortisol trends revealed similar findings, with higher religiosity scores when compared to participants who revealed subjectively higher stress with higher objective cortisol responses (p=.027). A possible explanation for these responses is that if individuals believe in something bigger than themselves, and understand that there are aspects of their life that are controllable and aspects that are not, this framework may allow individuals to focus on the former and dismiss the latter. In this context, participants who scored higher in the spirituality/religiosity domains had an ability to focus and act upon the task presented, i.e., within their control, and dismiss the physiologic response to the external factors, i.e., the involuntary physiologic response to the noise, smell, and harassment when transmitting the 9-line medical evacuation request. In other words, the recognition that there are situational elements that are out of one’s control plays a role in perceived stress or perceived difficulty. While religiosity and spirituality did not achieve statistical significance, the analysis of this small sample size suggests

that there may be a relationships between religiosity and perceived stress (r [35] = -.202, p=.11) and perceived difficulty (r [36] = -.269, p=.051).

Effect of problems or obstacles on the results

As with any project, a number of difficulties were encountered during the conduct of the protocol or identified after the protocol was closed to accrual.

Sample size not achieved. The mean attrition rate for the cohorts was 13.3% (range 0-25%), attributable to the attrition rate of 31% in the final group. This, coupled with the fact we did not have an opportunity to oversample a subsequent cohort to achieve our projected sample size led to our inability to achieve our full complement. A plausible explanation is that the last cohort included all experienced nurses, and the participants were uniquely different from the first three cohorts, comprised of Lieutenants. While the doubled attrition rate could not have been projected for this last group, it would have been prudent to attempt to recruit participants for the final group based on the highest attrition rate observed to date versus the mean attrition rate for the previous groups. A decision was made to stop recruitment at 38 participants, i.e., prior to achieving the approved sample size of 40. It was reasonable to stop recruitment for the following three reasons: (1) The primary aims of the study include feasibility testing for recruitment and calculation of an effect size and these aims are achievable based on a sample size of 38 participants. (2) It is conceivable that adding an ACEP training course for only 2 participants would introduce limitations in the analysis. The intervention for these individuals would be uniquely different from the previous ACEP courses administered with a lower instructor: student ratio than in previous courses, i.e., the additional personalized attention for 10% of the intervention cohort could bias the findings in favor of ACEP training effects. (3) Finally, the budget did not account for a 5th ACEP training course, affecting the time commitment from LTC Ohlson and the funding required to bring LTC Ohlson to Joint Base Lewis McChord, WA from West Point, NY.

Potential contamination of the target population. Implementation of a brief introduction to the components of the IFAK kit may have contaminated the "novice" group. The performance scores were higher in the control group. It is plausible that the temporal relationship to the introduction class influenced the higher scores and the control group had less time between the introduction and the CCSS than the intervention group.

Incorrect performance sheet used for cohort. In a preliminary analysis of the performance data, there was a floor effect on the performance scores in the CCSS. It was decided to approach this difficulty in two ways. First, we attempted identify whether the floor effect was a result of the individuals being novice nurses. To this end, we recruited individuals with greater clinical and deployment experience to determine if the consistently low performance scores was related to no nursing/deployment experience versus inability of the ACEP training program to influence performance. We therefore expanded our inclusion criteria to experienced nurses with a deployment history as recommended. Second, we attempted to modify the scoring of the tasks and the MSTC staff were requested to give participants "partial credit" for the tasks completed that began in the third and fourth cohorts. For example, if a tourniquet is applied, but not in the correct location, instead of a complete failure, they lost a standardized proportion of the *original*

overall score. Despite this effort, however, when completing data entry/hygiene, it was discovered that the partial credit scores were modified on an incorrect version of the score sheet. All lists were scrubbed for like items and like scores were assigned to each task.

Protocol deviations identified after redeployment. Prior to deployment, arrangements were made for the research team to have oversight of the protocol. Dr. Lori Loan (AI) agreed to supervise Ms. Pierce, the project director (PD) and meet with her on a regular basis to ensure she had appropriate mentorship and guidance during this time (February 2010 through October 2010). COL Mittelstaedt was named as the primary investigator on the protocol in my absence, adhering to TSNRP requirements for a military member to assume responsibility of the protocol in the absence of the original name and primary investigator. COL Mittelstaedt was not aware of the deviations in this study.

Three deviations reports were filed for this study as follows:
(1) The PD had an ICF in the trunk of her vehicle. When the PD and the PI were going to be medical simulation training center, the PI noted the consent form in the trunk, and the PD picked it up immediately and secured it. The issue of securing ICFs appropriately was addressed at a later date, and Ms. Pierce acknowledged the oversight. The signed consent form was in the project director's vehicle for approximately 2 weeks; no other individuals accessed or reviewed the consent form.
(2) When preparing for the November 2010 audit, the PI found email communication regarding recruitment of an individual who was TDY. The PD apparently sent the individual the consent form and she agreed via email to participate at which time she was randomized into the treatment group. She signed a consent form upon her return to JBLM and filled out the intake surveys. It was only after she signed a consent form did she fill out any questionnaires, participate in the intervention training, and engage in the performance evaluation at the simulation center. The PD was made aware of the inappropriate method of recruitment and that the participant should not have even been randomized to the treatment/control group. Dr. Loan was also made aware of this issue and she stated that Ms. Pierce did not have the appropriate oversight.
(3) As a credentialed FNP at MAMC the PI was qualified to assess any patients who endorsed questions suggestive of homicidal/suicidal ideation. While the PI was deployed, the PD enrolled three participants who endorsed the question "Thoughts of death or dying". One was escorted to Behavioral Health and followed the intent of the protocol; two others upon her further questioning, stated this question was endorsed because of their occupation as a nurse. Prior to deployment, PI coordinated with BH to have participants assessed for HI/SI if these questions were endorsed. Notes from participant 29: *"Thoughts are not negative—centered around the natural process that death and dying is. Declined referral for One Source or Behavioral Health"*. Notes from participant 45: *"Participant explained that he is a critical care nurse and sees death/people dying. Thought of death and dying are not centered around him. BH triage was contacted. They explained that the clinic is self-referral unless I thought he was an immediate threat to himself or others. I told them I did not feel he was any kind of threat at all."* The PD consulted registered nurses (AI: Lori Loan, Collaborating staff: Mary McCarthy) about the two participants, and per her report, Drs Loan and McCarthy determined that Ms. Pierce was not required to pursue any further courses of action. After the PIs redeployment, these notes were found and brought to the attention of Drs Loan and McCarthy because the PDs contract expired and she was no longer on the protocol. Dr. Loan indicated that they could initial her previous

documentation, demonstrating that they concurred with her assessment and this would meet the intent of the protocol. I further explained that this was not per protocol and an evaluation of a credentialed health care provider was mandated, however, no further responses from Drs Loan or McCarthy were received. A corrective action plan was discussed with Adam Dubov, MAMC's Human Protection Administrator. Both participants were contacted, and provided information on rationale for follow up call; participants deny depression, homicidal/suicidal ideation.

Ms. Pierce was a new PD, and the measures that were put in place to prevent problems from arising failed. Upon reflection, she reports that the AI was not readily available for questions that arose. It was clear that she did not have adequate supervision from the research team. Given some of the problems that have arisen on this protocol during my deployment, I have had discussions with both Dr. Lori loan, and the Geneva staff that consideration for putting protocols on hold should be given when the primary investigator is gone for extended periods. In the future, there must be consideration for a detailed plan that is drafted and filed with DCI in the PIs absence.

Limitations

There are methodological limitations of this pilot study worth noting that if possible necessitate correcting on any future studies. The most significant limitation of this study is the small sample size. While serving the primary aim of the study, we were limited in our ability to examine fully all variables of interest. The other somewhat limiting factor was the outcome of interest: performance in the CCSS. While acceptable for a pilot study, the discrepancy in scores for the chest patient was not devastating, but somewhat problematic. In the last cohort of participants, however, the Medical Simulation Center developed the ability to record the cameras used to zoom in closely to observe the participants' activity in greater detail than we experienced with the three cameras used for the majority of participants in the study. Having this capability and developing strict procedures to address interrater reliability for more accurate scoring will ensure the primary outcome of interest for a larger study is reflected accurately.

Regarding the salivary biomarkers, while we used multiple sampling on the day of the study to capture effects of anticipation anxiety seen in the presence of mental stress, we do not have comparisons on a different day when participants were not exposed to a unique stressor, so it is unclear if the baseline samples are elevated from non-stress basal levels. Despite the robust physiologic response noted in the overall sample analyses, it may have been somewhat tempered by the notion that a simulation scenario in a controlled setting contributes to both a dampened physiologic response and a lower perceived stress of the scenario. Moreover, the elevations in blood pressure and heart rate in the anticipation phase may be attributable to the movement from the Rest phase to the staging area for the CCSS. This is somewhat mitigated by the fact in most cases the average of two blood pressures separated by two minutes were obtained, allowing for some recovery and the heart rate was an average of the 10 minute Anticipation period. The immediate post-CCSS blood pressure reactivity was impressive, however, the blood pressure was not taken during the CCSS to avoid interrupting sequence of care and preparation of the medical evacuation request, but in doing so may have missed an opportunity to identify the magnitude of the peak blood pressure response.

Finally, while representative of the Army Nurse Corp gender distribution, the sample was disproportionately female and all were officers, and the findings of this study may not be generalizable to enlisted nursing staff, other branches of the Army, or members of other services.

Conclusion

In the present study, we integrated new measurement and training technology to explore stress response patterns in Army Nurses to a simulation of a highly chaotic and complex environment--a standardized CCSS. Specifically, we examined individual differences in biobehavioral reactivity and regulation of Army Nurses in response to a medically relevant combat training scenario and examined the effects of a MST intervention. Results suggest the CCSS is an effective stressor, with large magnitude increases in all physiologic parameters. While participant randomized to the MST intervention did not perform better, performance analysis between groups suggests a moderate effect size of the MST intervention in novice nurses with no IFAK training. Examination of the cognitive mental fitness skills data and the physiologic reactivity and recovery suggests there may be improvement in imagery, mental practice, focus/refocus, and competition planning as well as differences in physiologic regulation attributable to the training. Age, gender, perceived difficulty of the CCSS, and previous nursing experience were associated with individual differences in the magnitude of the physiological responses. Additionally, multiple psychosocial domain scores were associated with higher physiologic reactivity. Lower levels of performance-related to triage and treatment were associated with higher levels of reactivity and slower recovery for some of the physiological measures. The findings raise important questions regarding the utility of integrating measures of the psychobiology of the stress response into training programs designed to prepare first responders to handle highly complex and chaotic rescue situations.

Significance of Study or Project Results to Military Nursing

The findings suggest MST may be a useful to improve mental fitness skills and physiologic regulation in Army Nurses exposed to unpredictable, chaotic, and complex situations. Although nurses do not engage in combat patrols, being first responders to combat casualties is plausible: nurses may be assigned to US Special Operations units, live on bases subjected routinely to indirect fire, or travel extensively within the theater of operations. Rote knowledge of "Common Soldier Tasks" (e.g., basic medical care, map reading, requesting medical evacuation of casualties) is essential, but equally important is the ability to respond immediately and process information from multiple sources in an unpredictable environment. Effective individual engagement and decisive action leading to successful completion of tasks has the best chance for optimal outcomes on the battlefield. In this process, elevated levels of ANS and HPA activity during these high stress conditions may interfere with nurses' performance.

Technical advances afford the opportunity to create realistic environments with challenging simulations that can be standardized and used for both training and evaluative purposes. These advances raise the possibility that with integration of salivary analytes into simulated environments, training programs may be designed to teach individuals self-regulation strategies and manage their biological and behavioral sensitivities. Development and mastery of skills that enhance self-regulation, followed by application to contexts extending beyond the scope of the original training may translate into significant downstream positive consequences for programming effectiveness, behavioral adjustment, and maximizing individual performance. Interpreted within the historical framework of ideas linked to "biological sensitivity to context" (Wiener, 1992), the findings of this pilot study raise important questions regarding the degree to which individual differences in the psychobiology of the stress response moderate how Army Nurses prepare for, perform during, and adapt after engaging in highly complex and chaotic rescue situations. Nurses function as en route providers for critical care patients in the combat theater, managing life threatening conditions of wounded service members (e.g., hemodynamic changes, ventilator adjustments) during transport to higher level treatment facilities (Davis & Connelly, 2011). Extending beyond task performance, this is an important issue that could be related to risk or resilience for the expression of downstream psychosocial problems (e.g., PTSD), and would appear to be a specific area in which intervention, training or specific prevention efforts could be applied. In other words, it may be important to teach Army Nurses strategies that enable them to rethink and resolve the events in their subjective experience during that immediate post-event period. There persists a common belief among service members that admitting psychological vulnerability will have detrimental effects on their occupation (Bray, et al., 2006) and stress-distress is likely to go underreported not only for this reason, but also because identifying a need for help is counter to cultural norms of stoicism and perhaps contradict one's self identity as a combat veteran.

The depth of knowledge is relatively shallow with respect to our understanding of how individuals adjust and adapt when they are asked to perform in complex and chaotic environments. This study suggests that doing so has the potential to reduce errors in the triage and treatment of battlefield casualties and theoretically ameliorate the risk for subsequent stress-related adjustment problems among Army Nurses. Not only is identification of individuals who most need this training important, but so too is the conduct of the training. The next generation of studies must evaluate where there are individual differences in habituation of physiological

reactivity and regulation to these types of complex tasks. For some, reactivity in this setting is due to its novelty, and the reactivity would dampen quickly with repeated exposures. For others, reactivity in this setting will not habituate, and for those individuals we expect they need different training, otherwise they are the most likely to make mistakes and are the most likely to suffer the downstream negative consequences (PTSD; (Yehuda, 2001). The integration of measures of the psychobiology of the stress response and of an overarching conceptual model of "biological sensitivity to context" into training programs for Army Nurses is novel and adds value beyond the more subjective and traditional self-report and self-assessments. Such assessments may be useful in targeting individuals who would benefit from additional training to modulate their physiologic response to acute stress. Whether repeated exposure to environmental conditions integrated with occupational tasks is of greater benefit to facilitate comfort and habituation to stressful events than mastery of coping skills and/or techniques that facilitate self-regulation during acutely stressful events is unclear, and warrants further exploration.

The Army continues to stress the importance of mental and emotional resilience and mental fitness skills including mandatory training for all military occupations. In theory, such skills can improve confidence, self-awareness, and self-regulation, enhancing human performance in uniquely stressful contexts. Unquestionably, optimal performance is critical during unpredictable, chaotic situations; whether mental fitness skills can not only be taught effectively but also sustained to allow for generalization remains unclear. Further research is necessary to examine the relationship between both resilience programs and mental fitness skills training and how they influence performance outcomes and the psychological sequelae that burden military personnel.

Changes in Clinical Practice, Leadership, Management, Education, Policy, and/or Military Doctrine that Resulted from Study or Project

No overarching changes in clinical practice/education/policy/military doctrine have been made to date, and was not the intent of this pilot study. Based on preliminary observations, however, the Clinical Nurse Training Program at MAMC incorporated a brief training of combat casualty first aid. In the planning phase of the study, there was a basic assumption that all nurses had training and/or exposure to the Improved First Aid Kits (IFAK) prior to their assignment to MAMC. In post-participation focus groups, however, it was determined that there was a lack of familiarity/exposure to the content of the IFAKs *and* a lack of training. Identification of these knowledge gaps could very well explain the floor effect observed on the performance scores of the novice nurses because there was a perceived knowledge deficit for the critical skill set required to treat the simulated casualties effectively. During the PIs deployment, an unintended action occurred when the temporary on-site PI who was also the Chief of the Madigan Consolidated Education Department, added the additional training to the Clinical Nurse Training Program based on observations and feedback in the focus groups (see relevant comments in Appendix A). While beneficial from the perspective of exposing novice Army nurses to the IFAK and ensuring a minimum level of familiarity with the contents and coordinating education to address the shortfall of this Common Soldier Task, it was detrimental to evaluation of new Army Nurse performance in the CCSS since there was the possibility of contamination for this cohort (n=12).

References Cited

Bray, R. M., Hourani, L. L., Olmstead, K. L. R., Witt, M., Brown, J. M., Pemberton, M. R., et al. (2006). *2005 Department of Defense Survey of Health Related Behaviors Among Military Personnel* (No. RTI/7841/106-FR). Research Triangle Park, NC: RTI International.

Byrd-Craven, J., Geary, D. C., Rose, A. J., & Ponzi, D. (2008). Co-ruminating increases stress hormone levels in women. *Horm Behav, 53*(3), 489-492.

Davis, R. S., & Connelly, L. K. (2011). Nursing and En Route Care: History in Time of War. *The United States Army Medical Department Journal*(October-December), 45-50.

Gottlieb, G. (1992). *Individual development and evolution: The genesis of novel behavior*. New York: Oxford University Press.

Hammermeister, J. J., Pickering, M., McGraw, L. & Ohlson, C.J. (2010). Relationship between psychological skill profiles and soldier physical fitness performance. *Military Psychology,* 22, 399-411.

Lieberman, H. R., Bathalon, G. P., Falco, C. M., Kramer, F. M., Morgan, C. A., 3rd, & Niro, P. (2005). Severe decrements in cognition function and mood induced by sleep loss, heat, dehydration, and undernutrition during simulated combat. *Biol Psychiatry, 57*(4), 422-429.

McEwen, B. S. (2008). Central effects of stress hormones in health and disease: Understanding the protective and damaging effects of stress and stress mediators. *Eur J Pharmacol, 583*(2-3), 174-185.

Morgan, C. A., 3rd, Southwick, S., Hazlett, G., Rasmusson, A., Hoyt, G., Zimolo, Z., et al. (2004). Relationships among plasma dehydroepiandrosterone sulfate and cortisol levels, symptoms of dissociation, and objective performance in humans exposed to acute stress. *Arch Gen Psychiatry, 61*(8), 819-825.

Pieper, S., Brosschot, J. F., van der Leeden, R., & Thayer, J. F. (2010). Prolonged cardiac effects of momentary assessed stressful events and worry episodes. *Psychosom Med, 72*(6), 570-577.

Selye, H. (1998/1936). A syndrome produced by diverse nocuous agents. 1936. *J Neuropsychiatry Clin Neurosci, 10*(2), 230-231.

Tartaro, J., Luecken, L. J., & Gunn, H. E. (2005). Exploring heart and soul: effects of religiosity/spirituality and gender on blood pressure and cortisol stress responses. *J Health Psychol, 10*(6), 753-766.

Taylor, M. K., Sausen, K. P., Potterat, E. G., Mujica-Parodi, L. R., Reis, J. P., Markham, A. E., et al. (2007). Stressful military training: endocrine reactivity, performance, and psychological impact. *Aviat Space Environ Med, 78*(12), 1143-1149.

Weiner, H. (1992). *Perturbing the organism: The Biology of Stressful Experience*. Chicago: University of Chicago Press.

Yehuda, R. (2001). Biology of posttraumatic stress disorder. *J Clin Psychiatry, 62 Suppl 17*, 41-46.

Summary of Dissemination

Type of Dissemination	**Citation**	**Date and Source of Approval for Public Release**
Publications	None	
Publications in Press	None	
Manuscripts in review	McGraw, L., Out, D. Hammermeister, J., Pickering, A., Ohlson, C., & Granger, D. Nature, Correlates, and Consequences of Stress-related Biological Reactivity and Regulation in Army Nurses during Combat Casualty Simulation. *Psychoneuroendocrinology submission November 2011*	Submitted for PAO approval
Published Abstracts	None	
Podium Presentations	None	

Poster Presentations	1. McGraw, L., Loan, L., Ohlson, C., Pickering, M., Hammermeister, J. Performance of Army Nurses in a Combat Casualty Stress Scenario Western Institute of Nursing Research Conference, Las Vegas, NV April 15, 2011 2. Geneva Foundation Open House, August 16, 2011	January 26, 2011; cleared through Madigan PAO/OPSEC, Department of Clinical Investigation
Media Reports	None	
Other	None	

Reportable Outcomes

Reportable Outcome	Detailed Description
Applied for Patent	None
Issued a Patent	None
Developed a cell line	None
Developed a tissue or serum repository	None
Developed a data registry	None

Recruitment and Retention Table

Recruitment and Retention Aspect	Number	
Subjects Projected in Grant Application	81 potential participants for anticipated enrollment & completion of 40	
Subjects Available	57 novice ANs 17 experienced ANs	
Subjects Contacted or Reached by Approved Recruitment Method	74	
Subjects Screened	50	
Subjects Ineligible	3	
Subjects Refused	24	
Human Subjects Consented		
Subjects Intervention Group / Control or Sham Group	24	23
Intervention Group / Control or Sham Group Subjects Who Withdrew	5	4
Intervention Group / Control or Sham Group Subjects Who Completed Study	19	19
Intervention Group / Control or Sham Group Subjects With Complete Data	19	19
Intervention Group / Control or Sham Group Subjects With Incomplete Data	0	0

Demographic Characteristics of the Sample

Characteristic	
Age (yrs)	28.5 ± 6.5
Women, n (%)	28 (74)
Race	
White, n (%)	29 (76.3)
Black, n (%)	3 (7.9)
Hispanic or Latino, n (%)	2 (5.3)
Native Hawaiian or other Pacific Islander, n (%)	1 (2.6)
Asian, n (%)	2 (5.3)
Other, n (%)	1 (2.6)
Military Service or Civilian	
Air Force, n (%)	0 (0)
Army, n (%)	38 (100)
Marine, n (%)	0 (0)
Navy, n (%)	0 (0)
Civilian, n (%)	0 (0)
Service Component	
Active Duty, n (%)	38 (100)
Reserve, n (%)	0 (0)
National Guard, n (%)	0 (0)
Retired Military, n (%)	0 (0)
Prior Military but not Retired, n (%)	0 (0)
Military Dependent, n (%)	0 (0)
Civilian, n (%)	0 (0)

Final Budget Report

Appendix A

Relevant Focus Group Notes on Common Soldier Task Training

Technical Aspects:

5 of the 6 had never even seen an IFAK before (the one that had was an ROTC graduate) and didn't know that the casualties would have what the supplies necessary for treatment. Even OBC graduates said they had not seen the contents of an IFAK .

They suggested ….. telling them that all the supplies they need to treat the casualties will be in the room/on the casualty.

Lack of training/preparedness:

All wanted more deployment preparation and more exposure to combat scenarios.

One talked about her technical performance: handling each task, knowing he proper steps to take was not necessarily at the level the participant hoped she would be at.

They stated that if they were more comfortable with their soldier skills they would have been able to put in more effort and perform better during the scenario.

All agreed they do not get enough common Soldier task training and would like more of it. They are getting enough hospital/patient training but not enough training to prepare them as a soldier needing to give medical treatment.

They train everyday for what they do in the hospital but do not train at all for going into a combat situation.